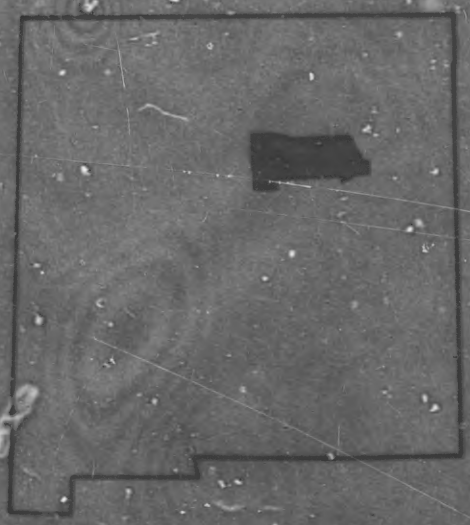
JUN 13 1986
FEMA 1.209:350068
594 c 31

FLOOD INSURANCE STUDY

COMPLETED ORIGINAL
48



CITY OF LAS VEGAS, NEW MEXICO
SAN MIGUEL COUNTY

SEPTEMBER 18, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 350068

51
BEST COPY AVAILABLE

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgements	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	8
3.0	ENGINEERING METHODS	8
	3.1 Hydrologic Analyses	9
	3.2 Hydraulic Analyses	10
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	11
	4.1 Flood Boundaries	12
	4.2 Floodways	12
5.0	INSURANCE APPLICATION	16
	5.1 Reach Determinations	16
	5.2 Flood Hazard Factors	16
	5.3 Flood Insurance Zones	18
	5.4 Flood Insurance Rate Map Description	18

BEST COPY AVAILABLE

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	19
7.0 LOCATION OF DATA	19
8.0 BIBLIOGRAPHY AND REFERENCES	19

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Potential 100-Year Flood Height on Gallinas Creek	7
Figure 3 - Photograph of Channel Conditions on Gallinas Creek	7
Figure 4 - Floodway Schematic	15

TABLES

Table 1 - Five Highest Recorded Flows - Gallinas Creek	5
Table 2 - Major Bridges in the Las Vegas Area	6
Table 3 - Summary of Discharges	10
Table 4 - Floodway Data	13 - 14
Table 5 - Flood Insurance Zone Data	17

EXHIBITS

Exhibit 1 - Flood Profiles

Gallinas Creek	Panels 01P-03P
Arroyo Pecos	Panels 04P-06P
Arroyo Hermanos	Panels 07P-08P
Arroyo Pajarito	Panels 09P-10P

Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

BEST COPY AVAILABLE

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

BEST COPY AVAILABLE

FLOOD INSURANCE STUDY
CITY OF LAS VEGAS, NEW MEXICO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Las Vegas, San Miguel County, New Mexico, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Bohannan-Huston, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C-1209. This work was completed in January 1985.

1.3 Coordination

On April 15, 1983, streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, the City of Las Vegas, and Bohannan-Huston, Inc. (the study contractor). Results of the hydrologic analyses were coordinated with FEMA, the Soil Conservation Service (SCS), the U. S. Geological Survey (USGS), and the U. S. Army Corps of Engineers (COE). On November 14, 1985, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the city, and the study contractor.

BEST COPY AVAILABLE

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Las Vegas, San Miguel County, New Mexico. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: Gallinas Creek for its entire length within the corporate limits; Arroyo Pecos from the downstream corporate limits to U. S. Route 85; Arroyo Hermanos from its confluence with Gallinas Creek to Lopez Street; and Arroyo Pajarito from its confluence with Gallinas Creek to Salazar Street. A shallow flooding area on the right bank of Gallinas Creek (looking downstream) from approximately 500 feet downstream of Raynolds Avenue to Interstate 25 was also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through January 1990.

A small unnamed tributary to Gallinas Creek and the remaining portions of Arroyo Pecos, Arroyo Hermanos, and Arroyo Pajarito were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Las Vegas.

2.2 Community Description

The City of Las Vegas is located in the west-central portion of San Miguel County in north-central New Mexico, approximately 40 miles east of the City of Santa Fe. It is completely surrounded by unincorporated areas of San Miguel County.

Situated at the divide between the Sangre De Cristo Mountains and the eastern New Mexico plains, Las Vegas is a historic stopping poin on the old Santa Fe Trail. In the early 1900s, the city thrived on the activities surrounding the Atchison Topeka and Santa Fe Railway. Today, the pace has slowed from that of earlier railroad times. Las Vegas is a quiet rural community consisting mainly of residential and small business areas, with an emphasis on the historic quality of the city. As home of Highlands University, much of the Las Vegas activities center around a collegiate atmosphere. Small farms scattered throughout the countryside have sparked the development of an extensive irrigation system that surrounds Las Vegas.

BEST COPY AVAILABLE

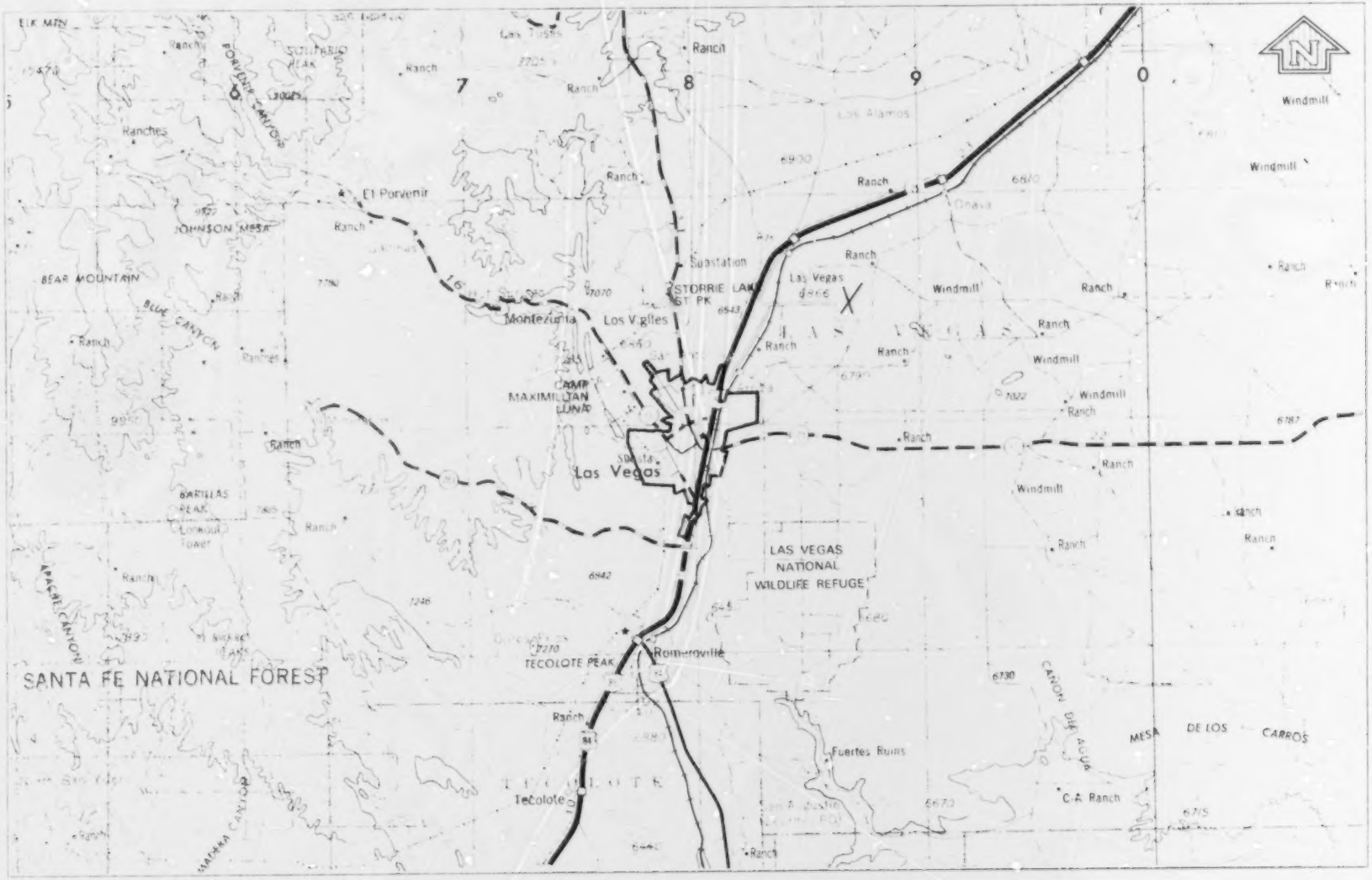


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Little development has occurred around Las Vegas recently. Significant development affecting the flood plains is not expected within the next five years.

Elevations in the Las Vegas watersheds vary from over 12,000 feet in the Sangre De Cristo Mountains to below 6,400 feet at the southern end of the city. Slopes of the streams range from over four percent in the high mountains to approximately one percent in the city. The two major streams affecting Las Vegas are Gallinas Creek and Arroyo Pecos.

Gallinas Creek originates on the eastern slope of the Sangre De Cristo Mountains northeast of Las Vegas. Before passing through the center of the city, a large portion of the Gallinas Creek flows are diverted into the Storrie Lake intake canal. The remaining portion of Gallinas Creek enters Las Vegas from the north. As the stream travels through the center of the city, its banks are bordered by business, residential, and educational districts. Vegetation in the flood plains consists of mature trees, understory brush, and heavy grasses.

Most of the Arroyo Pecos flows begin on the mesa east of Las Vegas where they collect along the eastern edge of the city and begin flowing south. It eventually merges with Gallinas Creek southeast of Las Vegas. Approximately 20 percent of the Arroyo Pecos basin begins in the Sangre De Cristo Mountains north of Gallinas Creek. These waters are temporarily stored by SCS floodwater retarding dam No. 1, located north of Storrie Lake and Las Vegas. The Arroyo Pecos flows are slowly discharged from the flood control structure into the North Storrie Lake intake canal where they enter Storrie Lake. Arroyo Pecos is bordered by Interstate 25 to the west and irrigated farmlands to the east. Vegetation along the channel consists mainly of grasses due to the recent interstate construction and channel improvements.

Arroyo Hermanos and Arroyo Pajarito are small streams located in west Las Vegas. They pass through the residential area on the west side of the city before flowing into Gallinas Creek near National Street and Prince Street.

2.3 Principal Flood Problems

Spring snowmelt, mountain springs, and summer thundershowers are the primary sources of water to maintain the normal flows for the streams in the Las Vegas area. However, flood stages are generally produced as the result of intense sustained rainstorms that occur most frequently from August through October.

BEST COPY AVAILABLE

Historic information on area flooding is primarily available for Gallinas Creek. Arroyo Pecos and other streams around the Las Vegas area can be expected to behave in a manner similar to Gallinas Creek, but to lesser magnitudes.

Five of the largest discharges on record for Gallinas Creek are listed in Table 1. Discharges shown in Table 1 are from the gaging station (No. 08380506) located near Montezuma, New Mexico (Reference 1).

TABLE 1 - FIVE HIGHEST RECORDED FLOWS - GALLINAS CREEK

Date	Stage* (feet)	Elevation* (feet)	Peak Discharge (cubic feet per second)
September 30, 1904	14.0	6,433.5	11,600
August 4, 1957	13.3	6,432.8	9,140
August 2, 1966	12.8	6,432.3	7,120
September 3, 1942	11.6	6,431.1	4,540
September 23, 1941	10.5	6,430.0	3,790

*Depth at upstream side of the National Street bridge based on 1983 conditions. Stream bed elevation is 6,419.5.

The maximum peak flow on Gallinas Creek occurred in 1904. The discharge of 11,600 cubic feet per second (cfs) was computed at a point 200 yards below the gaging station at Montezuma (Reference 2). During the night of September 29, 1904, four timber dams above Las Vegas and Hot Springs were washed out. The volume of water released destroyed three bridges above Hot Springs as well as the Hot Springs bath house and several masonry walls at the nearby railroad station located near the mouth of the canyon. Six miles down the valley, three more railroad bridges were washed out, and the railroad tracks were damaged. The old railroad station at Las Vegas, a large frame structure on the north bank of Gallinas Creek, was completely washed out due to erosion. The flood of 1904 had an estimated recurrence interval of approximately 120 years.

The most recent flood occurred in August 1966. Local newspapers reported that flows of over 5,000 cfs flowed down the Storrie Lake intake canal. This storm had an estimated recurrence interval of 55 years.

In 1971, flood damage occurred near the National Street and Prince Street bridges from an estimated peak flow of 863 cfs. The estimated recurrence interval was 8 years. As a result of this flooding, the City of Las Vegas requested help from the COE, and the COE completed an 8,000 cfs channel clearing project (Reference 3). Flood damage occurring in 1971

BEST COPY AVAILABLE

was most likely the result of sediment deposits and heavy vegetation in the channel of Gallinas Creek. If the damage-producing flood of 1971 is compared with that of the 1904 flood, the importance of keeping the channel clear of sediment and vegetation is easily seen.

Descriptive structural information for the Las Vegas area bridges is shown in Table 2.

TABLE 2 - MAJOR BRIDGES IN THE LAS VEGAS AREA

Description	Stream Location	Type of Construction	Maximum Roadway Elevation (feet)	Total Clear Width (feet)
Interstate 25	Gallinas Creek	Prestressed Concrete	6,401.6	290
A.T. & S.F. Railway	Gallinas Creek	Timber, Steel, Concrete	6,403.1	250
U. S. Route 85	Gallinas Creek	Steel, Concrete	6,406.3	231
Prince Street	Gallinas Creek	Steel, Concrete	6,410.7	189
National Street	Gallinas Creek	Concrete Arch	6,432.0	120
Mills Avenue	Gallinas Creek	Steel, Concrete	6,464.0	190
Interstate 25	Arroyo Pecos	Prestressed Concrete	--	---
A.T. & S.F. Railroad	Arroyo Pecos	Timber, Steel, Concrete	6,443.7	204
U. S. Route 85	Arroyo Pecos	Concrete Box	6,463.0	136
New Mexico Avenue	Arroyo Pajarito	Concrete Box	6,451.0	14
New Mexico Avenue	Arroyo Hermanos	Concrete Box	6,479.8	10

Figure 2 shows the potential 100-year flood height on Gallinas Creek at one location in Las Vegas. Figure 3 shows typical channel conditions of Gallinas Creek.

BEST COPY AVAILABLE

Figure 2 - Potential 100-year flood height on Gallinas Creek at the National Street bridge, looking northeast.

Figure 3 - Typical channel conditions of Gallinas Creek. This view, looking upstream from the National Street bridge, shows heavy vegetation in 1984.

BEST COPY AVAILABLE

2.4 Flood Protection Measures

North of Storrie Lake, Arroyo Pecos has a system of dams and levees which contain the flows originating above Storrie Lake. These structures provide protection to Storrie Lake and the upper portions of Arroyo Pecos, but they have only a minor influence downstream of Storrie Lake in the form of reduced flows.

No other riverine structures in the Las Vegas area meet the criteria needed to be classified as a flood control structure. However, the Storrie Lake diversion structure and adjoining intake canal will have an effect on the Gallinas Creek discharges through the City of Las Vegas. Storrie Lake water users and Gallinas Telcote Soil and Water Conservation District members maintain the Storrie Lake diversion structure as well as setting its gate levels. Under low flows, the diversion provides some protection to those on Gallinas Creek near Las Vegas by diverting water into Storrie Lake. However, the structural integrity of the diversion becomes questionable under high flows. In fact, should the structure fail, it may aggravate conditions downstream by suddenly releasing a volume of stored water. For purposes of this study, the Storrie Lake diversion is assumed to have no effect on the Gallinas Creek flows.

The Storrie Lake intake canal may possibly have similar effects to those of the diversion structure. Low flows could be diverted to Storrie Lake, thus reducing the amount of water traveling down Gallinas Creek and into Las Vegas. Again, however, the earthern levees which form sections of the canal could be overtopped under large flows. The position of the diversion structure gates will dictate the amount of water entering the canal. As evidenced by the record discharge of 1966, large volumes of water can be diverted into the canal. A breach in the canal levee could possibly discharge water into the unprotected valley areas to the south.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example,

BEST COPY AVAILABLE

the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for Gallinas Creek were based on 61 years of record at the gaging station (No. 08380500) near Montezuma, New Mexico. The discharges were determined using a log-Pearson Type III analysis as outlined in Bulletin 17B and USGS Open-File Report 81-1071 (References 4 and 1).

For the purposes of this study, the Arroyo Pecos watershed was divided into two sub-basins: the Canon Bonito and Storrie Lake sub-basin (25 square miles) and the remaining unregulated drainage area (58 square miles). The Canon Bonito flows were assumed to be contained in the SCS Arroyo Pecos floodwater retarding dam No. 1 (design inflow capacity of 15,000 cfs) (Reference 5). This structure releases a maximum flow of 300 cfs into Storrie Lake through the North Storrie Lake intake canal.

Storrie Lake does have significant freeboard capacity, and all available data indicate the emergency spillway at Storrie Lake has never discharged. The only outflow released from the lake is through the Storrie Project Irrigation Canal to the east. Therefore, the assumption was made that the contributing drainage area for Arroyo Pecos at Las Vegas is limited to the unregulated area of the basin.

Arroyo Pecos flood flows were estimated by plotting local gaging station flood-frequency data and the regression equations presented in USGS Water Resources Investigations 82-24 (Reference 6). Based on the local data, the regression lines were then shifted upward while maintaining the original slope of the regression equations.

Discharges for Arroyo Hermanos and Arroyo Pajarito were estimated in a manner similar to those of Arroyo Pecos. However, their drainage areas are very small, and different regression equations were used due to the lack of data available for small drainage basins in the area. The regression equations were taken from an administrative report by the USGS (Reference 7). These equations were used because they are based on small

BEST COPY AVAILABLE

drainage basins, and also because USGS Water Resources Investigations 82-24 states it should be used only for drainage areas greater than one square mile, which is not the case for Arroyo Hermanos and Arroyo Pajarito.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 3, "Summary of Discharges."

TABLE 3 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
GALLINAS CREEK					
At the downstream corporate limits	84	2,770	6,780	9,310	17,700
ARROYO PECOS					
At the downstream corporate limits	58	2,300	5,900	8,000	15,500
ARROYO HERMANOS					
At its confluence with Gallinas Creek	0.75	400	770	1,100	2,000
ARROYO PAJARITO					
At its confluence with Gallinas Creek	0.75	400	770	1,100	2,000

For the streams studied by approximate methods, discharges were determined using the method described above for Arroyo Hermanos and Arroyo Pajarito.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses of the streams studied by detailed methods were obtained from field surveys and topographic maps (Reference 8). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

BEST COPY AVAILABLE

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were determined using normal depth calculations.

The shallow flooding area on the right bank of Gallinas Creek (looking downstream) from approximately 500 feet downstream of Raynolds Avenue to Interstate 25 was determined using field surveys and engineering judgment.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

Stream	Channel "n"	Overbank "n"
Gallinas Creek	0.020-0.060	0.020-0.120
Arroyo Pecos	0.020-0.035	0.020-0.050
Arroyo Hermanos	0.020-0.070	0.020-0.070
Arroyo Pajarito	0.020-0.070	0.020-0.070

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For the streams studied by approximate methods, the extent of the 100-year flood was determined using normal depth calculations.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

BEST COPY AVAILABLE

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 8 and 10).

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the topographic maps referenced above and the Flood Hazard Boundary Map for Las Vegas (References 8, 10, and 11).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 4).

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Arroyo Pecos								
A	1,280	150	1,139	7.0	6,382.3	6,382.3	6,382.6	0.3
B	2,500	150	1,233	6.5	6,384.4	6,384.4	6,385.3	0.9
C	3,420	150	1,444	5.5	6,386.2	6,386.2	6,387.0	0.8
D	4,780	76	589	13.6	6,388.5	6,388.5	6,388.5	0.0
E	5,420	75	544	14.7	6,391.9	6,391.9	6,391.9	0.0
F	5,840	76	584	13.7	6,394.9	6,394.9	6,394.9	0.0
G	6,515	74	526	15.2	6,399.1	6,399.1	6,399.1	0.0
H	7,095	80	670	11.9	6,403.5	6,403.5	6,403.5	0.0
I	7,655	105	630	12.7	6,405.9	6,405.9	6,405.9	0.0
J	8,180	110	715	11.2	6,409.2	6,409.2	6,409.2	0.0
K	9,000	79	535	15.0	6,413.9	6,413.9	6,413.9	0.0
L	9,920	92	700	11.4	6,420.2	6,420.2	6,420.2	0.0
M	10,765	85	604	13.2	6,423.4	6,423.4	6,423.4	0.0
N	11,900	204	2,098	3.8	6,426.7	6,426.7	6,426.7	0.0
O	12,850	113	628	12.7	6,429.3	6,429.3	6,429.3	0.0
P	12,950	222	1,643	4.9	6,431.9	6,431.9	6,431.9	0.0
Q	13,325	179	676	11.8	6,431.9	6,431.9	6,431.9	0.0
R	16,515	157	646	12.4	6,451.3	6,451.3	6,451.3	0.0
S	16,670	124	636	12.6	6,455.3	6,455.3	6,455.3	0.0

[1]Feet above corporate limits

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOODWAY DATA

ARROYO PECOS

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Gallinas Creek								
A	350	106	802	11.6	6,379.8	6,379.8	6,380.6	0.8
B	920	100	706	13.2	6,383.3	6,383.3	6,383.8	0.5
C	1,770	199	905	10.3	6,389.7	6,389.7	6,389.7	0.0
D	2,500	225	997	9.3	6,392.5	6,392.5	6,393.4	0.9
E	2,520	230	1,048	8.9	6,392.7	6,392.7	6,393.5	0.8
F	2,850	200	969	9.6	6,396.0	6,396.0	6,396.0	0.0
G	3,570	242	1,453	6.4	6,399.4	6,399.4	6,400.4	1.0
H	3,590	257	2,006	4.6	6,401.4	6,401.4	6,401.4	0.0
I	3,770	191	1,106	8.4	6,403.5	6,403.5	6,404.2	0.7
J	3,990	190	1,396	6.7	6,405.0	6,405.0	6,406.0	1.0
K	4,400	286	1,406	6.6	6,408.4	6,408.4	6,409.2	0.8
L	4,470	201	1,414	6.6	6,409.1	6,409.1	6,409.9	0.8
M	4,505	202	1,874	5.0	6,411.4	6,411.4	6,412.0	0.6
N	5,335	130	728	12.8	6,416.6	6,416.6	6,417.0	0.4
O	6,225	200	998	9.3	6,421.8	6,421.8	6,422.8	1.0
P	7,250	151	1,420	6.6	6,432.9	6,432.9	6,432.9	0.0
Q	7,640	266	1,869	5.0	6,435.4	6,435.4	6,436.1	0.7
R	8,320	255	1,562	6.0	6,437.0	6,437.0	6,437.7	0.7
S	9,150	244	1,032	9.0	6,443.2	6,443.2	6,443.3	0.1
T	10,470	227	1,004	9.3	6,451.9	6,451.9	6,452.0	0.1
U	11,040	183	808	11.5	6,455.9	6,455.9	6,456.1	0.2
V	11,070	191	1,157	8.0	6,457.9	6,457.9	6,457.9	0.0
W	11,570	230	928	10.0	6,459.9	6,459.9	6,459.9	0.0

[1]Feet above corporate limits

BEST COPY AVAILABLE

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOODWAY DATA

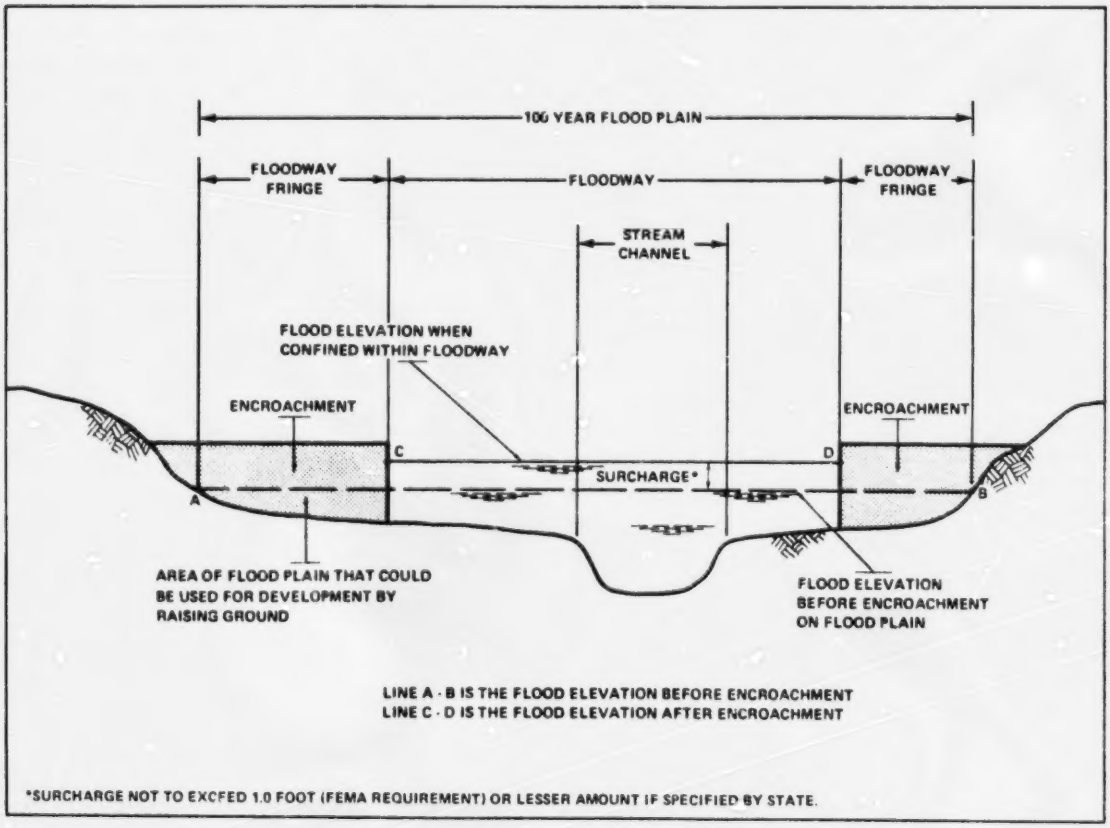
14

GALLINAS CREEK

No floodways were delineated for Arroyo Hermanos and Arroyo Pajarito since major portions of the flow for these streams are contained within the channel.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 4.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCFED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 4

BEST COPY AVAILABLE

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Las Vegas.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of Las Vegas are shown on the Flood Profiles (Exhibit 1) and summarized in Table 5.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

BEST COPY AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Gallinas Creek Reach 1	01,02	-2.8	-0.9	+2.2	030	A6	Varies
Sheet Flow Area From Approximately 500 feet downstream of Raynolds Avenue to Interstate 25	01,02	Shallow Flooding - Average Depths			1-3 Feet	AO	--
Arroyo Pecos							
Reach 1	01,02	-4.9	-1.4	+3.9	050	A10	Varies
Reach 2	01	-3.0	-0.8	+3.6	030	A6	Varies
Arroyo Hermanos							
Reach 1	02	-2.6	-1.1	+2.3	025	A5	Varies
Reach 2	02	-3.4	-1.6	+2.5	035	A7	Varies
Arroyo Pajarito							
Reach 1	02	-2.4	-1.0	+2.0	025	A5	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOOD INSURANCE ZONE DATA

GALLINAS CREEK–ARROYO PECOS
ARROYO HERMANOS–ARROYO PAJARITO

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone AO:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown but no FHFs are determined.
Zones A5, A6, A7, and A10:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 5.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Las Vegas is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

BEST COPY AVAILABLE

6.0 OTHER STUDIES

The COE previously published flows for Gallinas Creek in a report in January 1974 (Reference 3). The COE analysis resulted in discharges approximately two times the magnitude of the flows used in this study. Through correspondence with the COE, the discrepancy was found to lie in the method of analysis. The COE flows were based on a regional rainfall analysis, while this study uses a more detailed method based on actual stream gage data for Gallinas Creek. No other flood studies have been performed in the Las Vegas area, and no future studies affecting this study are expected in the next five years.

Due to a more detailed analysis, this Flood Insurance Study supersedes the previously published Flood Hazard Boundary Map for Las Vegas (Reference 11).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region VI Office, Federal Center, Denton, Texas 76201.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of the Interior, Geological Survey, Open-File Report 81-1071, Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico by Richard Thomas and April Dunne, Albuquerque, New Mexico, August 1981.

2. U. S. Department of the Interior, Geological Survey, Destructive Floods in the United States in 1904 by E. C. Murphy, Washington, D. C., 1905.

3. U. S. Army Corps of Engineers, Albuquerque District, Special Flood Hazard Information, Gallinas Creek, Albuquerque, New Mexico, January 1974.

4. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

5. U. S. Department of Agriculture, Soil Conservation Service, Drawing #4-E-19.059, Sheet 1, Albuquerque, New Mexico, March 1964.

6. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 82-24, Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico by Richard Thomas and Robert Gold, Albuquerque, New Mexico, March 1982.

BEST COPY AVAILABLE

7. U. S. Department of the Interior, Geological Survey, Small Streams Flood-Frequency Relations for the Central Rio Grande Valley of New Mexico, Albuquerque, New Mexico.

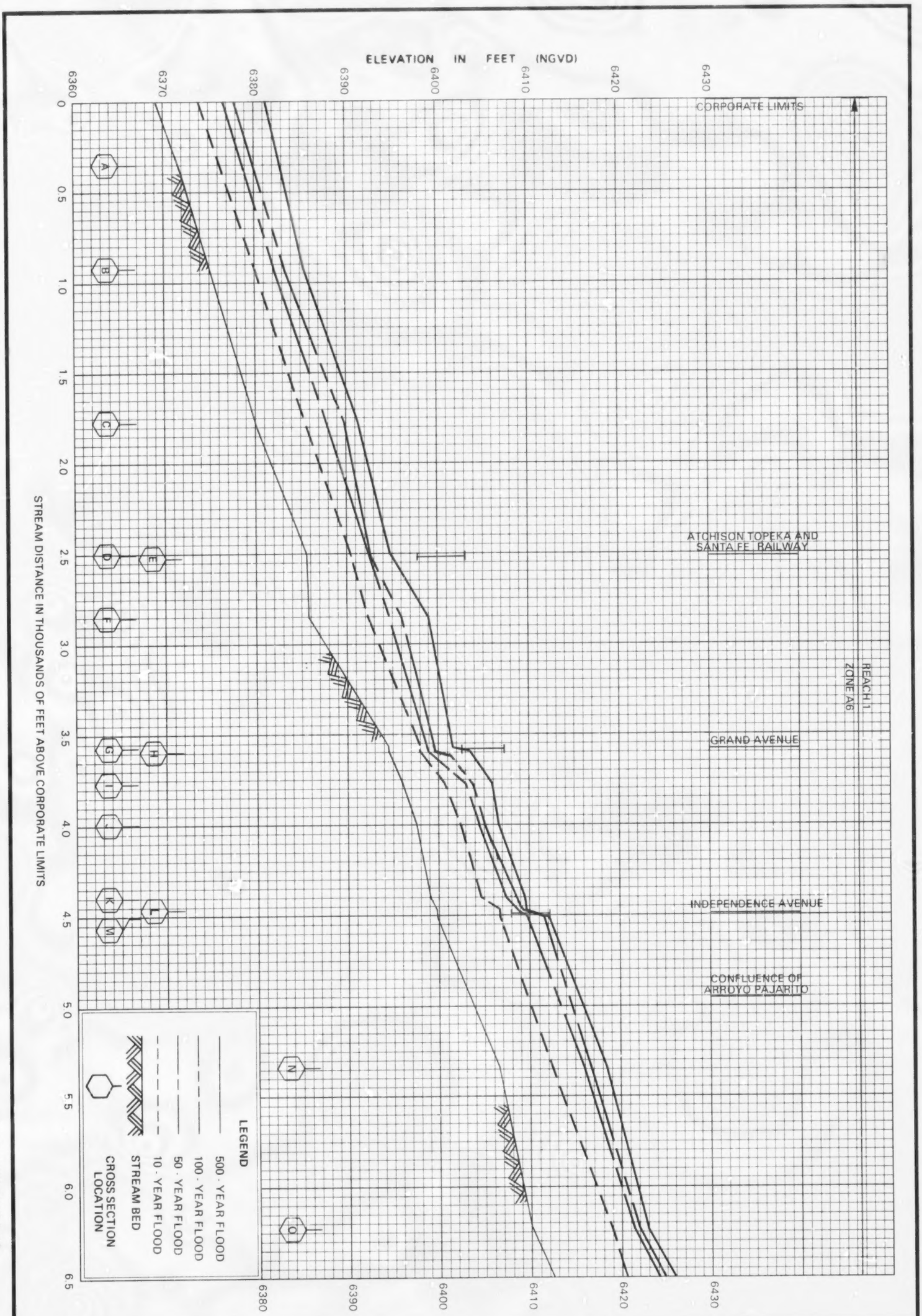
8. Bohannan-Huston, Inc., of Albuquerque, New Mexico, Topographic Maps, Scale 1"=400', Contour Interval 5 Feet: Las Vegas, New Mexico, 1973.

9. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, November 1976.

10. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Las Vegas, New Mexico, 1963.

11. Federal Emergency Management Agency, Flood Hazard Boundary Map, City of Las Vegas, San Miguel County, New Mexico, April 19, 1983.

BEST COPY AVAILABLE



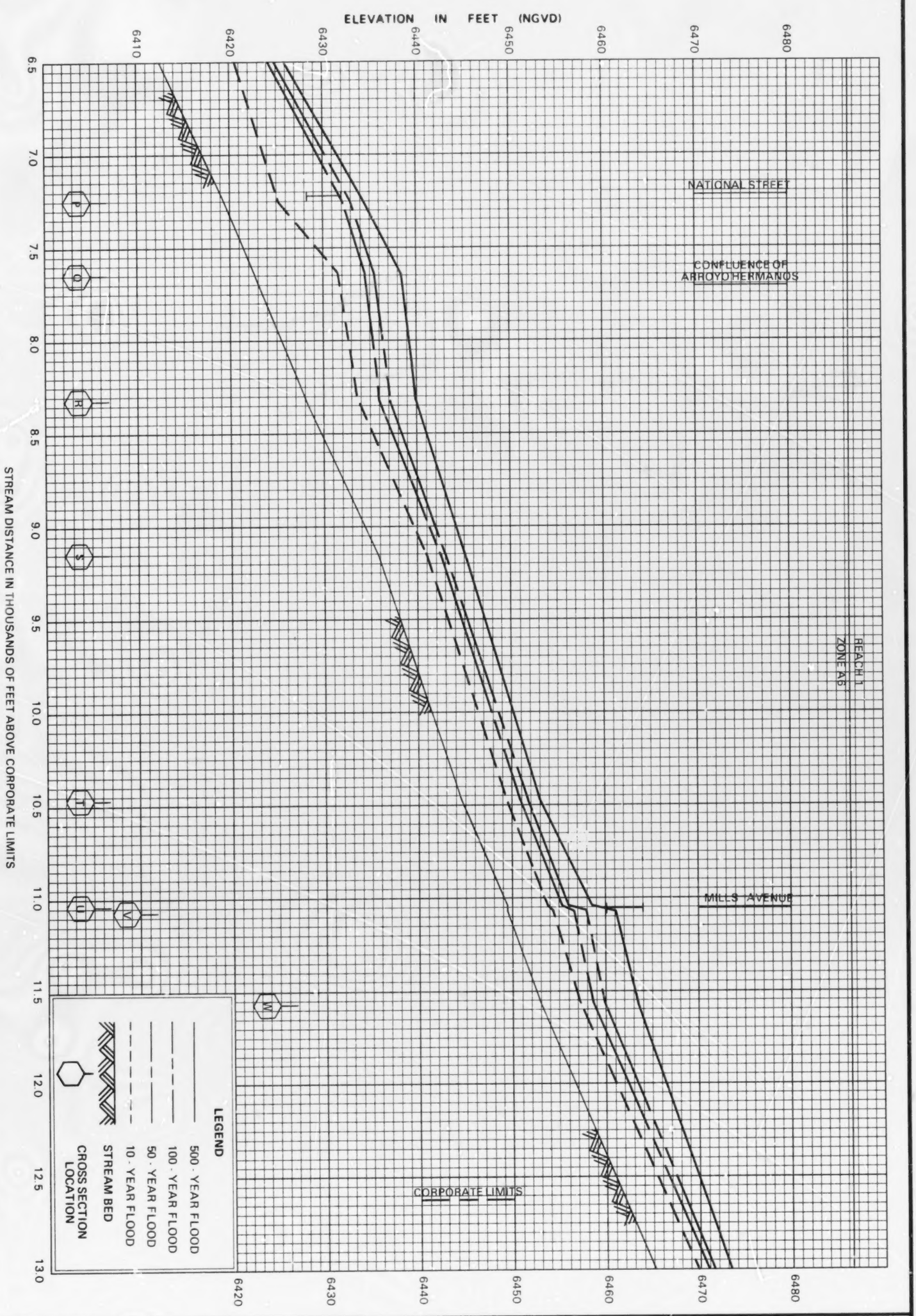
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOOD PROFILES

GALLINAS CREEK

01P



22

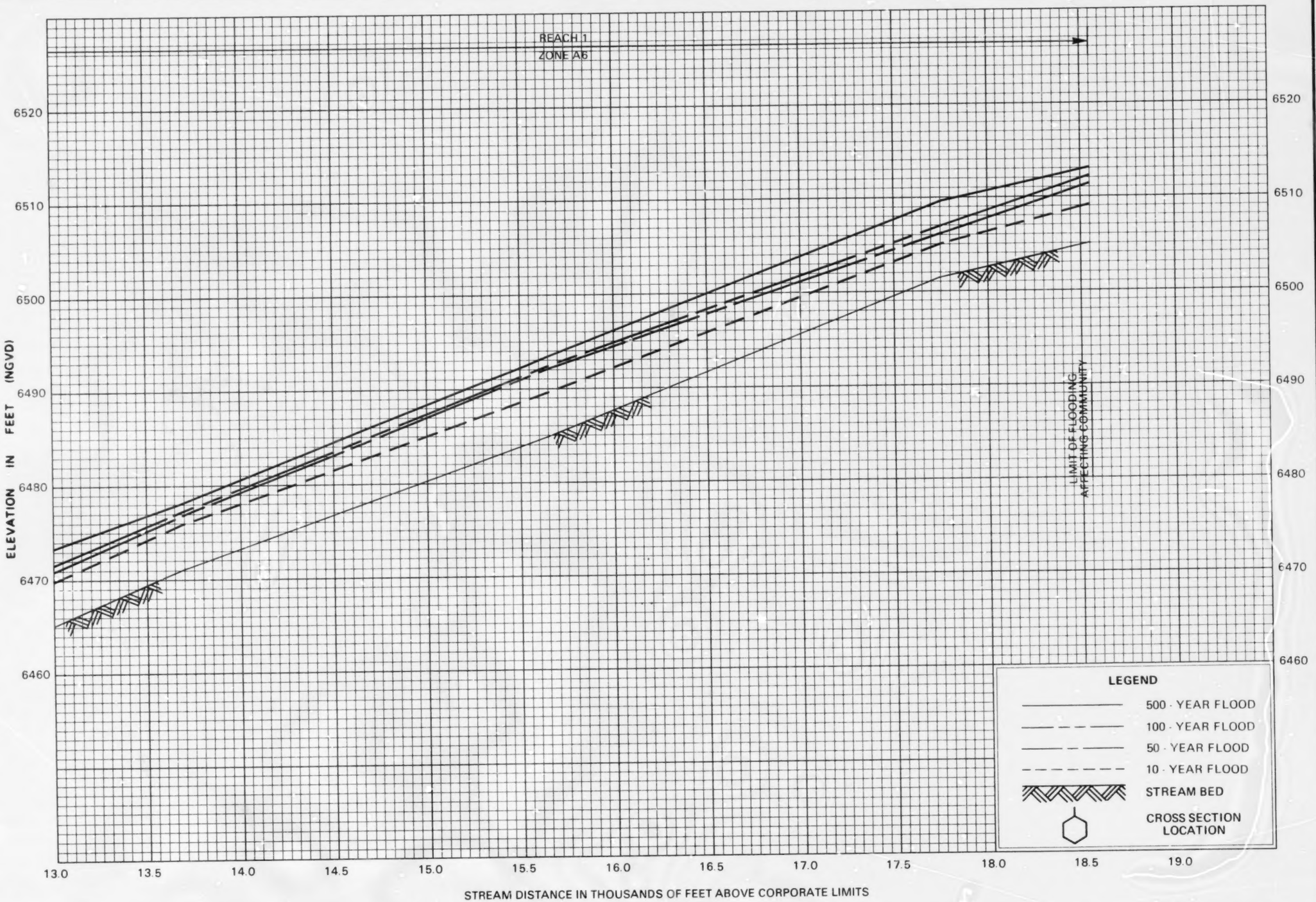
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOOD PROFILES

GALLINAS CREEK



FLOOD PROFILES

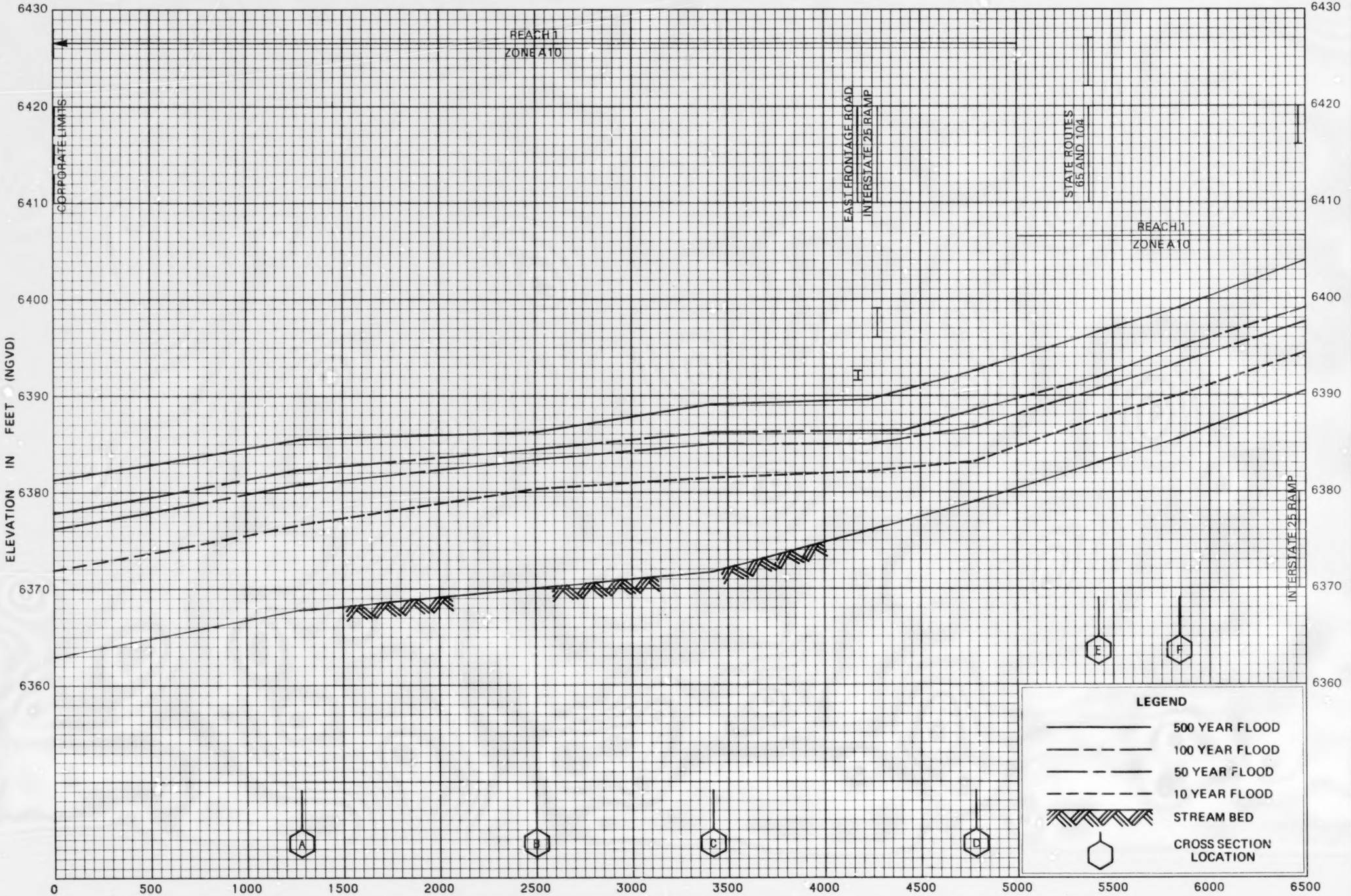
GALLINAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

03P

BEST COPY AVAILABLE



FLOOD PROFILES

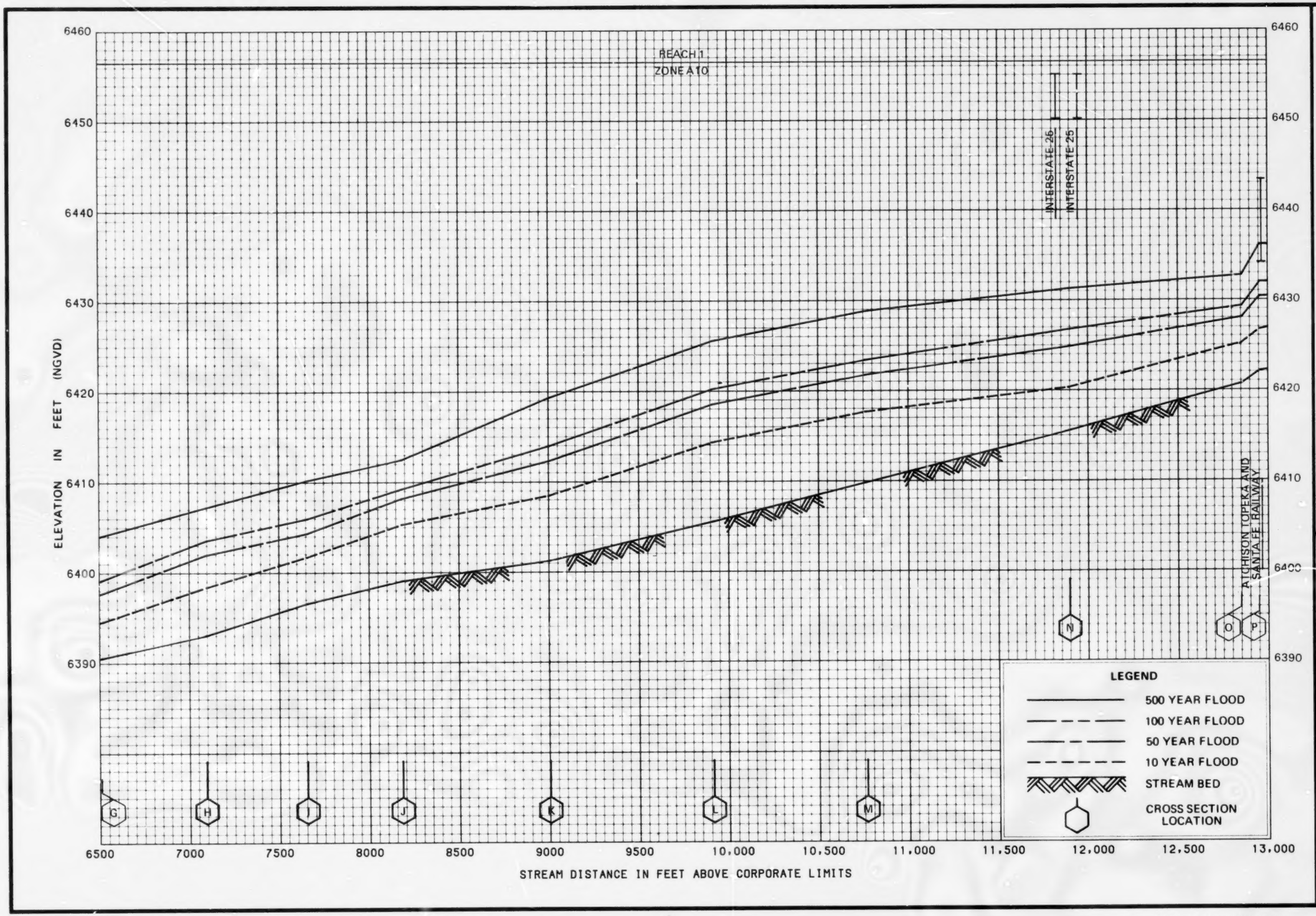
ARROYO PECOS

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

04P

BEST COPY AVAILABLE



FLOOD PROFILES

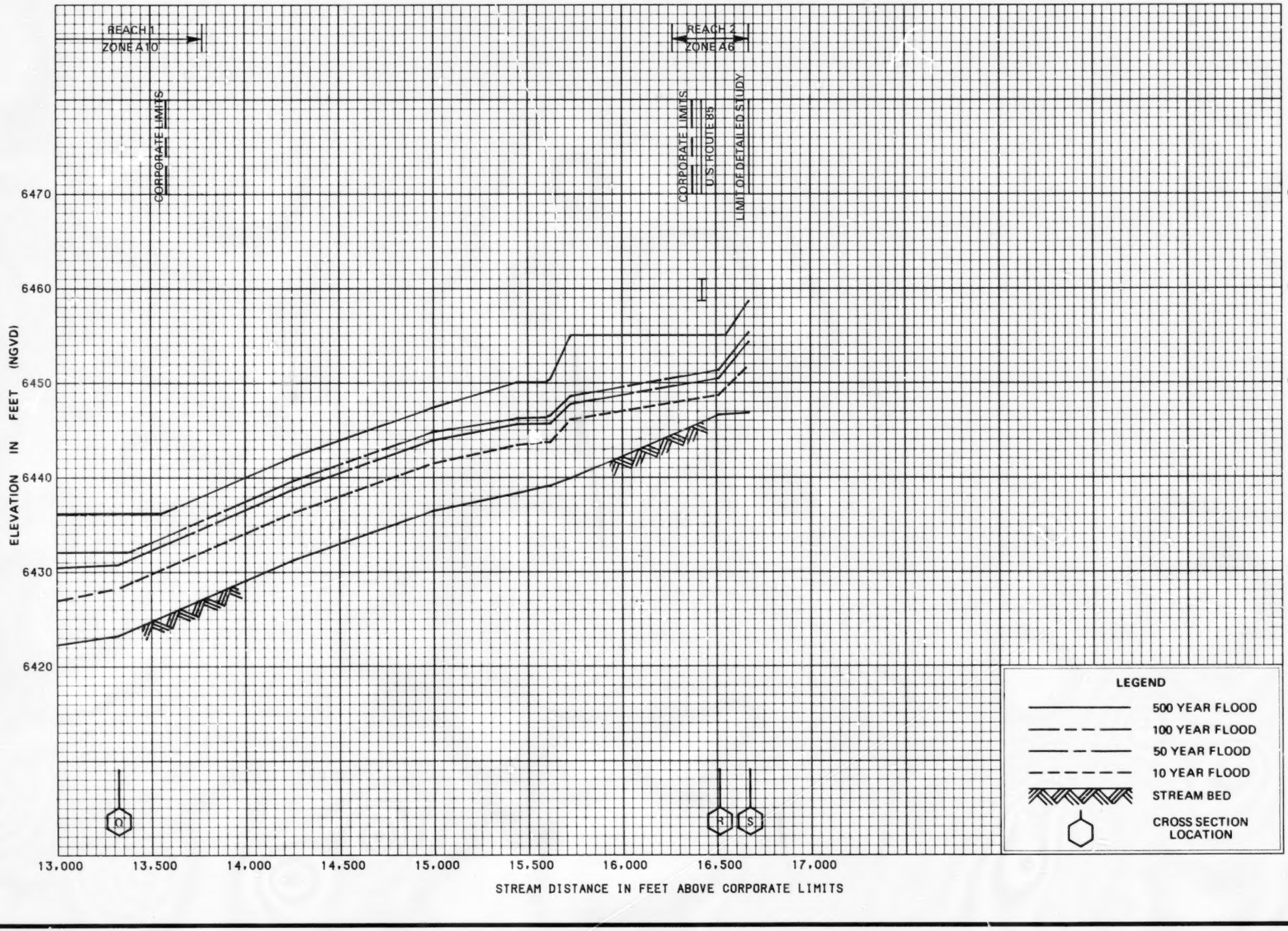
ARROYO PECOS

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

05P

BEST COPY AVAILABLE



FLOOD PROFILES

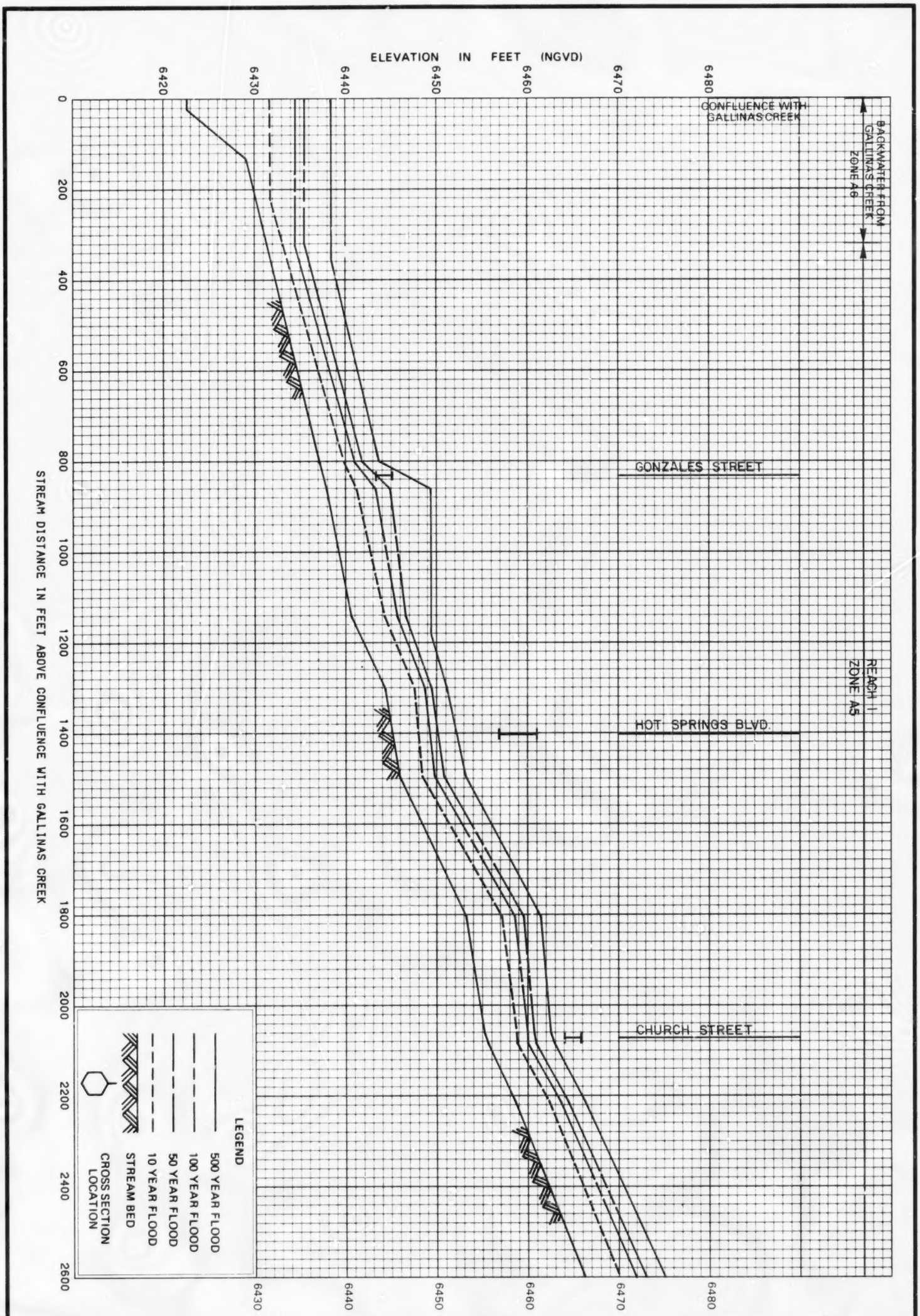
ARROYO PECOS

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

06P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

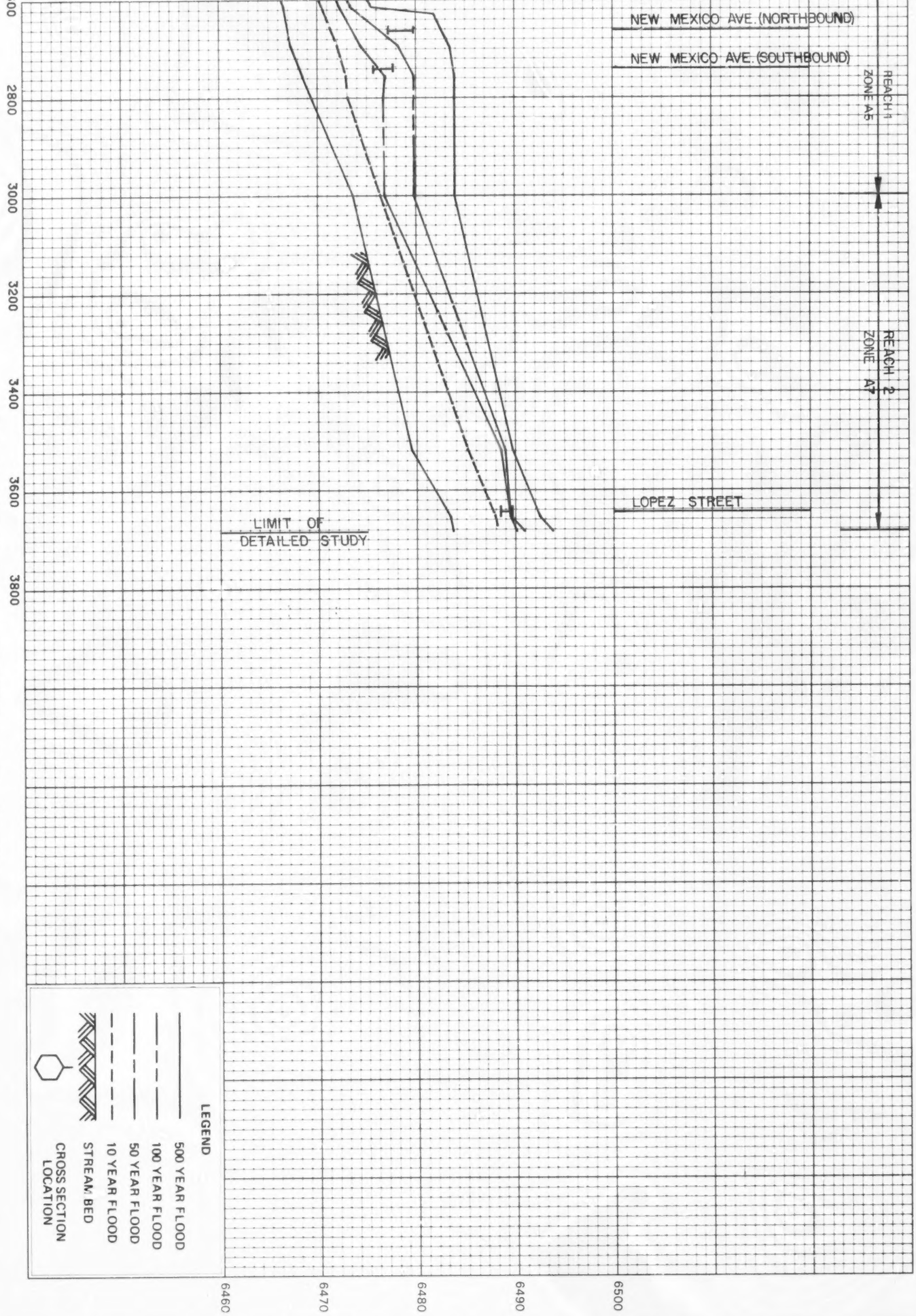
FLOOD PROFILES

ARROYO HERMANOS

07P

27

BEST COPY AVAILABLE



28

BEST COPY AVAILABLE

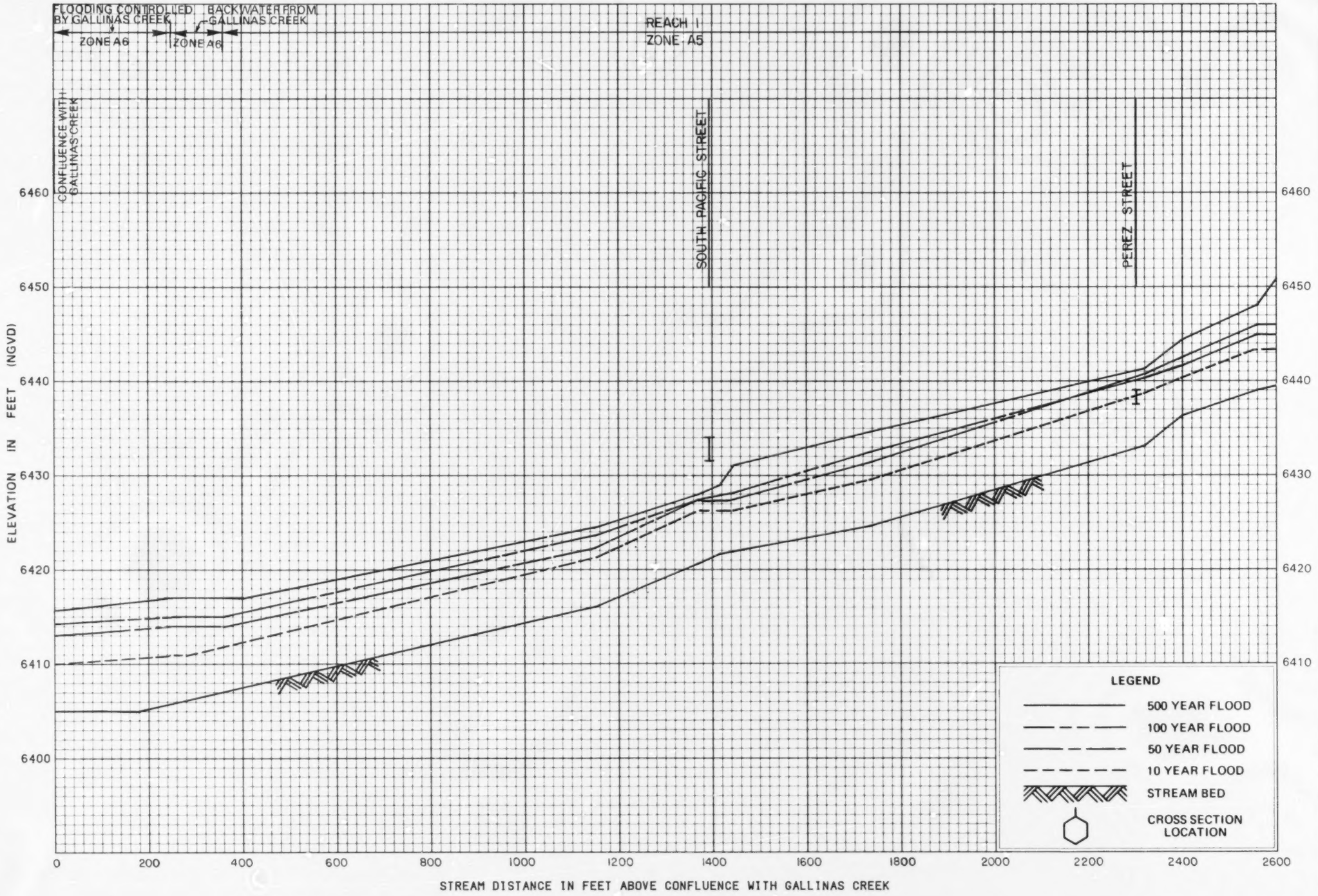
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOOD PROFILES

ARROYO HERMANOS

08P



FLOOD PROFILES

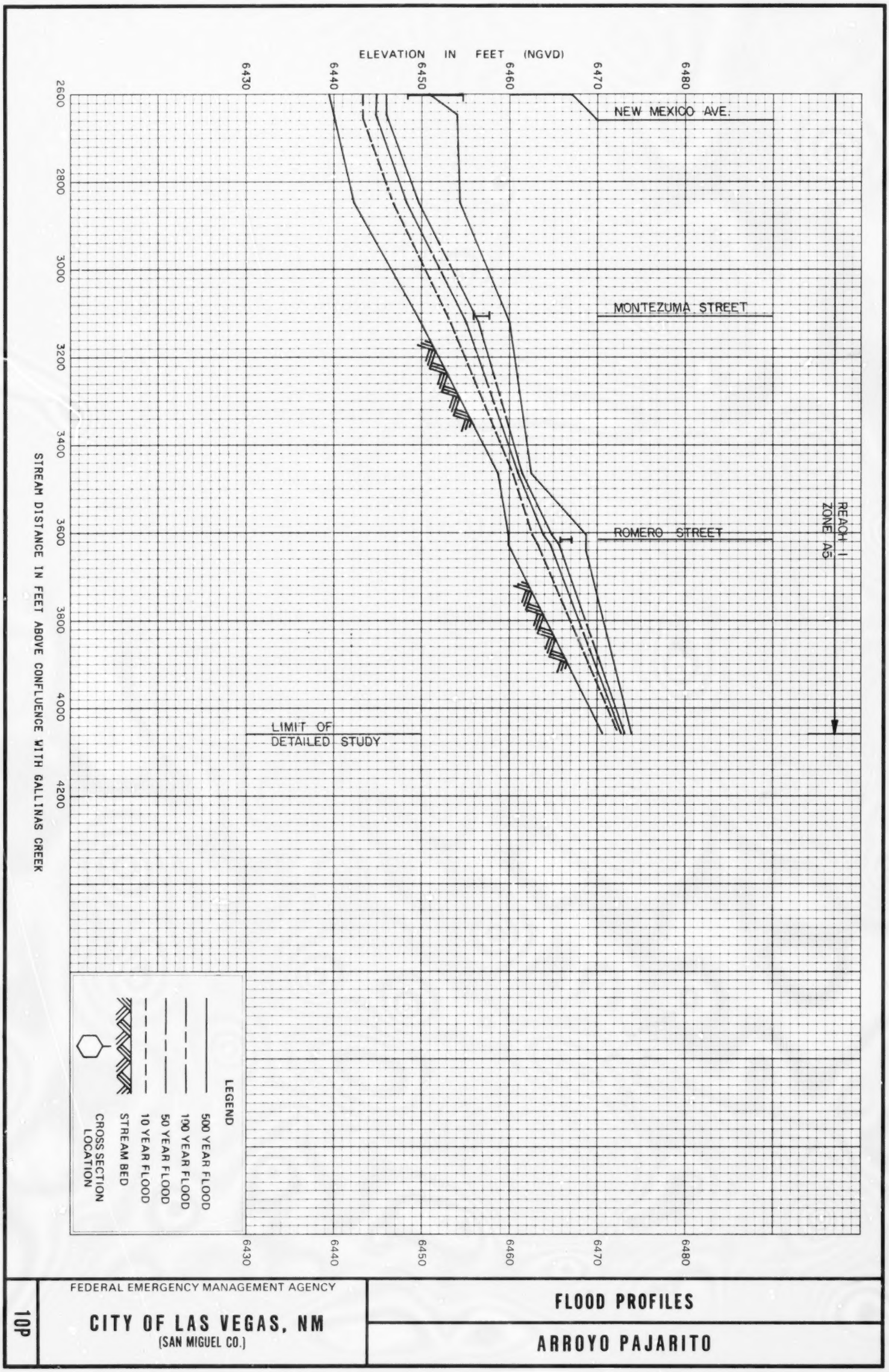
ARROYO PAJARITO

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

09P

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF LAS VEGAS, NM
(SAN MIGUEL CO.)

FLOOD PROFILES

ARROYO PAJARITO

10P

BEST COPY AVAILABLE